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ABSTRACT

This booklet offers a summary of research literature on educational productivity, as well as interpretive comments by the author on the implications of such research for restructuring educational programs at the elementary and secondary levels. The booklet is organized in three sections. Part 1 describes the principal methods and techniques used in school productivity research and discusses the strengths and shortcomings of each. Part 2 describes the findings of school productivity research, focusing especially on the impact of teacher characteristics, educational practices, school service organization, and pupil characteristics. Part 3 discusses the implications of what we know about school productivity for future public policy. (Author/JG)

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EDUCATIONAL PRODUCTIVITY: PUBLIC CONCERN AND LEGISLATIVE RESPONSE

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By Herbert J. Kiesling

NATIONAL CONFERENCE OF STATE LEGISLATURES
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While individual budgets tighten, demands for taxpayers' dollars for public education increase; yet student achievement standards often continue to decrease. Mounting public concern over the question of declining school standards calls for re-evaluation of the present elementary and secondary public school system in an effort to make it more productive. Dr. Herbert J. Kiesling of Indiana University addresses the economic complexities of administering present-day school systems in the attached monograph, *Educational Productivity, Public Concern and Legislative Response*. He summarizes research literature on educational productivity and suggests guidelines to be used by legislators and educational experts when implementing improvements to the nation's schools.

Dr. Kiesling's document provides an initial summary which identifies the variables which most directly affect public education productivity. It is divided into three parts: (1) a description of the principal methods and techniques used in school productivity and research and their strengths and shortcomings; (2) a delineation of the findings of the school productivity research focusing on teacher characteristics, educational practices, school service organization and pupil characteristics; and (3) a discussion of present knowledge about school productivity for future public policy.

The manuscript notes the positive and negative implications of trying to improve educational productivity. Techniques for evaluating educational productivity often presuppose conflicting assumptions which exacerbate the problems of educating legislators and administrators who need to formulate concrete public policy. Consequently, much educational research does not reveal new and consistent insights about how to increase educational productivity.

However, school productivity research studies do indicate that significant improvements in institutional quality could be introduced at reasonable costs. School districts could combine and share special services. New electronic aids including television programming and computers would increase the language ability of kindergarten pupils and first graders as well as decrease budgetary costs. Additionally, some research indicates that increasing class size will not negatively affect children above first grade level.

Naturally, teaching capacity greatly influences the quality of education. Dr. Kiesling stresses that the most influential factors of teacher performance must be distinguished. Increasing verbal aptitude and experience, rather than educational attainment and certification, will directly increase the achievement of students. Also, teachers must learn to deal with atypical and disadvantaged students who differ from the mass of normal students, and higher educational institutions must prepare teachers to address these specialized situations effectively. Advanced educational technology, performance contracting and cooperation among districts also could aid in the redirecting of teaching methods.

Yet how can the conclusions from productivity research be implemented? Goals must be defined, staffs improved and demonstration experiments constructed before innovative action will be taken by educators in American elementary and secondary schools. Present resistance to change and confusion about educational innovation will only be reduced after administrators and legislators understand the potential benefits of increased educational productivity.

The attached monograph will help legislators and administrators alike to begin questioning the productivity of their own school systems in a systematic fashion. Dr. Kiesling addresses problems which all educators encounter. He optimistically suggests that workable solutions can be derived through increasing legislative staff and through sponsoring demonstration projects, and through requesting the impartial assistance of research organizations such as the RAND Corporation or the National Institution of Education.

We trust this evaluation will help you to oversee your own school operations on an ongoing and professional basis. If any additional information is needed, please feel free to contact us.

Sincerely,

Earl Mackey

Mr. Earl Mackey
Executive Director
National Conference of
State Legislatures

National Conference of State Legislatures

Office of State Federal Relations

1150 Seventeenth Street, N.W. Suite 606 Washington, D.C. 20036 202/785-5614

Earl S. Mackey, Executive Director

Memorandum

Rising public concern over matters of educational productivity affect children, parents, teachers, taxpayers and public officials alike. In an era of declining enrollments, decreasing economic resources and diminishing public confidence in education, we all must find ways to improve the economic efficiency and educational effectiveness of our elementary and secondary schooling programs. A key way of accomplishing this task is to increase the productivity of our educational systems. This is not an easy task, however. Productivity in education is not always easy to measure; innovation too often meets with public misunderstanding and bureaucratic resistance, and Federal, State and local legislators all too frequently do not exercise an adequate amount of legislative oversight to insure the establishment and continuation of new, more productive educational programs.

This monograph by Dr. Herbert Kiesling of Indiana University, offers a thought-provoking summary of the research literature on educational productivity as well as interpretative comments about the implications of such research for restructuring educational programs at the elementary and secondary level. This document is no substitute for more thorough research into the many specific measures for improving educational productivity. Rather it is intended as an initial guide for the concerned legislator and citizen who wishes to improve the climate for increased educational innovation and productivity.

The Education Task Force of the National Conference of State Legislatures is proud to bring this information to you.

Sincerely,

Joseph C. Harder

Senator Joseph C. Harder
Chairman
NCSL Education Task Force

Gilbert E. Bursley

Senator Gilbert E. Bursley
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Introduction

Two decades ago, few Americans harbored serious doubts about the productivity of their public schools. Dollars spent on public schools almost universally were seen as a prudent investment outlay that assured a highly skilled labor force, a rising level of economic welfare, a responsible electorate and a stable society. Equally important, it was believed widely that greater expenditures on public schools could make them even more productive. Today, however, doubts about the productivity of public schools are widespread. While popular support for public schools remains essentially undiminished, there is substantial doubt that dollars for public schools are buying all that might be expected.

Questions about the productivity of public schools have arisen for several reasons. In major cities, blacks and members of other non-Anglo minorities have become painfully aware that their children all too often are not being educated at a level that permits them to qualify even for society's lowest status jobs. In suburbs, many middle class parents have become increasingly mystified by the apparent inability of public schools to imbue their children with the values of "Middle America" and the "Silent Majority." In some state capitols, elected officials have grown increasingly skeptical about calls for additional school funding in the face of declining pupil performance on many standardized achievement tests.

Importantly, there is little evidence that current doubts about school productivity will fade away. Indeed, there are several compelling reasons to believe that this concern will be elevated to a level of increasing prominence. First, educational outlays by local schools are continuing to grow in the face of declining pupil enrollments, a development which some groups regard as contrary to common sense. Second, the growing impetus of teachers toward unionization is raising doubts in many quarters about the professionalism of educators. Third, states faced with the task of equalizing educational opportunities as a result of recent court decisions are finding themselves increasingly caught in a fiscal and political squeeze which is compelling them to choose between "levelling-up" expenditures at a high tax cost, or finding ways to

equalize educational opportunities at minimum additional cost by making more effective use of existing dollars. Fourth, local school budgets in almost all communities have reached an absolute size which, like the federal defense budget, makes them a highly visible and tempting target to groups that are tax-conscious or who believe that education is overfunded compared to services in which they have a greater interest. And fifth, the nation's demographic characteristics are in the throes of important changes which are likely to reduce the priority our society has assigned to education over the last two generations. As our population grows older, as it continues to concentrate in metropolitan areas, it almost inescapably will express much greater interest in services like health, hospitals, welfare and environmental protection. Accordingly, public schools will find themselves in greater and greater competition for available tax dollars and, in turn, in a situation where they may find it increasingly necessary to meet their needs through greater productivity rather than out of additional dollars.

Significantly, the increasing importance of the school productivity issue has served to stimulate a large body of school productivity research. The basic objective of this research has been to determine the educational outcomes that can be expected under varying conditions of school service delivery. This objective, however, has been pursued by many different methods and techniques, most highly quantitative and complex. Accordingly, it should not be surprising that the results obtained by this research often have been contradictory and couched in terms that cannot be understood by most public officials and laymen. Recognizing this problem, the National Conference of State Legislatures commissioned Dr. Herbert Kiesling to develop a summary of existing school productivity research which *could be* understood by the average reader. This summary draws in large part from Dr. Kiesling's more detailed work for the National Commission on Productivity.

Dr. Kiesling's summary of the school productivity literature is divided into three parts. The first part describes the principal methods and techniques used in school productivity research and discusses the strengths and shortcomings of each. The second part describes the findings of the school productivity research, focusing especially on the impact of teacher characteristics, educational practices, school service organization and pupil characteristics. Finally, the third part discusses the implications of what we know about school productivity for future public policy.

PART I

School Productivity Research: Why Its Findings Are Conflicting

The increasing importance of school productivity as an economic and political issue has stimulated a large body of research on the relationship between educational inputs and outputs and between the resources devoted to schooling and the payoffs. Significantly, most of this research gives strong support to the proposition that educational inputs and outputs are directly related. It is widely divided, however, on the strength of the connection both overall and in specific areas.

The conflicting findings of school productivity research have long left many laymen and educational policymakers in a state of confusion, wondering why the findings are at odds, wondering what findings could be believed, and wondering whether any findings could be translated into public policy. This report will attempt to alleviate this confusion by presenting a straightforward summary of the school productivity literature, focusing first on its assumptions and techniques, then on its findings, and finally on the question of implementation.

Assumptions: A Basic Cause of Conflicting Findings

Like research on any subject, research on school productivity is based on assumptions. These assumptions, however, tend to vary greatly in three areas: (1) the method used to study productivity; (2) the techniques used to measure the factors under investigation; and (3) the treatment of factors that are related both to school productivity and to one another. This part of the report will describe some important differences in the assumptions made in each of these areas and demonstrate how they affect the findings of school productivity research.

Methods of Study

Most school productivity studies examine the relationship between educational inputs and outputs through one of three methods: (1) "multivariate analysis," (2) "experimental-control analysis," and (3) "broad educational interventions." The multivariate analysis method is characterized by a high

degree of statistical sophistication and aims at showing the relationship between two factors like teacher experience and pupil performance on standardized tests, the influence of other factors like parental income being held equal or constant. The strength of the approach stems from three factors: the use of comparable measures of performance across large experiments, accounting systematically for differences in socioeconomic background, and treating the school as a complete system in which different experiments can be related to each other. Although, because of data limitations, it is not possible to place too much weight on the results of any single study, together they provide a useful body of insights.[1]

Multivariate studies, however, tend to be weak in certain respects as well. First, they usually are not based on direct observation of the educational process; thus, may not adequately reflect the realities of the situation under consideration. Second, they generally are not based on conditions subject to manipulation by the researcher except by resort to statistical tools; thus, are subject to distortions caused by "overcontrolling" for either socioeconomic or schooling variables. And third, they usually depend on data describing groups or communities rather than individuals; hence, have only limited predictive power about individuals.

Some of the weaknesses of multivariate studies are overcome by the hundreds of research monographs on school productivity done by resorting to the experimental-control approach. Produced mainly by psychologists, the experimental-control studies generally aim to understand productivity by placing school children in situations where the researcher has broad control over most of the factors which are suspected to affect the aspect of productivity under investigation. Often, in this kind of study, two groups of children are matched carefully and then one is given an experimental treatment while the other is not. What these studies gain in precision and control, they often lose, however, in generality. Thus, while the findings of any one study may be quite valid, they may be couched in such specific terms that may neither apply over a wide range of circumstances nor have a great deal of importance for public policy.

Finally, studies of the effectiveness of different types of broad educational interventions are related to the experimental-control studies, but are much broader in scope and generally more important in their implications. These are treatments devoted to "groups of children as a whole in diverse programs taken as a whole."[2]

The purpose of most of these interventions is to overcome the effects of socially disadvantaged environments. Because of this special purpose, broad applications of the findings to other types of students would be dangerous. The central findings about the attributes of successful programs of this kind were

[1]The discussion here is heavily dependent upon the following two surveys: Harvey A. Averch and others, *How Effective Is Schooling? A Critical Review of Research*, Englewood Cliffs, N.J., 1974. D. Jamison, D. Smith, P. Suppes, S. Wells, "The Effectiveness of Alternative Instructional Methods," in Productivity and Efficiency in Education, Federal Council of Science and Technology (Mimeo.), Washington, D.C., 1972.

[2]M. Sterns, "The Effects of Preschool Programs on Children and Their Families," Mimeo, 1971.

developed by Bissell, but they seem to be substantiated by the comments of other investigators as well.[3]

Techniques Used to Measure Variables

An important source of conflict in the findings of school productivity research emerges from the way in which researchers decide to measure the factors considered in their investigations. Although each general approach to the productivity issue—the multivariate method, controlled experiment method, and social intervention method—tends to favor certain measurement techniques over others, all three are often deeply divided on questions relating to the measurement of pupil intelligence and achievement. Some investigators feel that these factors can be measured meaningfully and with adequate precision through existing instruments, such as the Stanford-Binet Test or the Scholastic Aptitude Test. Other investigators take quite the opposite view, holding that most standard measures of intelligence and achievement are grossly inadequate due to such shortcomings as cultural bias that works against racial and ethnic minorities, and their failure to take stock of intelligence and achievement except in a very narrow context. Such measures are probably adequate for broad statements concerning effectiveness and productivity, but they must be interpreted carefully.

Assumptions About Interdependent Variables Related to Outcomes

The results and interpretations of school productivity research are influenced not only by the way in which key variables are measured, but also by the treatment given to certain variables which are closely related not only to educational payoffs but also other variables that are closely associated with the same educational payoffs. Perhaps the classic example is the differing treatment given to school expenditures and family background as they relate to pupil achievement. As many studies show, school expenditures and family background are not only closely associated with one another, but also with pupil achievement. Some studies, however, have made theoretical and statistical assumptions which have led them to conclude that the most important cause of variations in pupil achievement is home background, while others have made different assumptions which have led them to conclude that the most important cause is school expenditures.

Quite clearly, it is beyond the scope of this report to conclude that some assumptions of school productivity research are better or more desirable than others. It is important, however, to indicate two things about these assumptions. First, they cannot be ignored when evaluating school productivity research. Second, and as the next part of this report will demonstrate, the wide range of assumptions used in school productivity research yields findings which, for all their conflicts, show that schools can make a difference and that public policy could be used to assure that they make more of a difference.

[3]See Averch, *et al.*, pp. 117 ff.

PART II

The Principal Findings of School Productivity Research

Wide variations in their methods and techniques aside, studies of school productivity tend to examine the relationship between educational inputs and outcomes chiefly in terms of four sets of variables: teacher characteristics, service organizations, service delivery procedures and pupil characteristics. A description and discussion of what is known about these factors follows.

Teacher Characteristics

The single-most costly component of school budgets, teachers and their impact on educational outcomes, has been examined from a variety of perspectives including (1) years of professional experience; (2) educational attainment; (3) salary level; (4) certification; and (5) verbal skills.[1]

1. Years of Teaching Experience

Finding. More than a dozen studies examine the relationship of teacher experience to pupil performance and about half indicate a direct association.

Interpretation. Two important factors determine teachers' salary increases after school districts hire them: number of years of teaching experience and number of degrees (together with graduate hours of credit). This finding provides some support for the conclusion that teacher experience is related to pupil performance. However, teacher experience is a difficult quality for decision-makers to regulate in existing schools because once teachers receive tenure (which generally occurs fairly early) school districts have made commitments to keep them on the faculties during their entire careers.[2]

2. Educational Attainment

Finding. Of the eight studies which considered the relationship of the level of teacher education to pupil performance, only one found a significant relationship.

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[1]The outcomes for teacher characteristics discussed in this section were obtained in multivariate type studies.

[2]Teacher mobility is extremely low in American schools because of the policy in most school districts of transferring only a fraction of the experience in another school district for purposes of the longevity calculation that is so important in determining salary level.

Interpretation. Of the two important teacher salary factors just mentioned, the second, degree level and number of course hours, appears to be unrelated to student performance. One important aspect of delivery methods employing professionals is through preparatory training. This training theoretically enables professionals to perform well in their careers without close supervision. These findings suggest that this scenario does not describe the reality with respect to American teachers.

3. Salary Level

Finding. Teacher salary was related to average student performance about half the time in eight studies where this relationship was considered. This same proportion held true for both salary policy and average salary.

Interpretation. The studies specified the teacher salary variable in different ways. Most studies used average salary, and this reflects three separate influences: experience, education level, and school district salary policy (whether the district pays uniformly more than other districts in the surrounding area).

Unfortunately, two few studies used policy variables sound enough to reach even tentative conclusions about the influence of salary policy by itself. This is the salary aspect which is of special interest in this discussion because it can be controlled by schools as they exist now. The findings from these studies provide some grounds at least for the belief that school salary policy is related to educational quality.

4. Certification

Finding. Eight studies considered the teacher certificate variable; less than one-fourth of the relationships tested were significant.

Interpretation. Delivery systems which depend upon the judgment of independent professionals to determine quality of service usually require some certification procedure. This finding suggests that the certification process in elementary and secondary education is not highly successful in guaranteeing that those who pass can provide high quality service.

5. Teacher Performance on Verbal Aptitude Tests

Finding. In a majority of instances in which a simple teacher verbal aptitude test was used, teacher scores were related positively and significantly to student performance. However, the number of data sets where such test scores were available were very few.

Interpretation. This is the only variable discussed here which represents a measure of a teacher's individual personality or capabilities. The implications of this finding to the organization of education are difficult to assess. Educational psychologists often find that (verbal) ability is highly related to I.Q.[3]

If this test is an I.Q. measure, then it is important to note that this is a quality which is unaffected by any attribute of the present educational system

[3]See, e.g., P. Lohnes, *Measuring Adolescent Personality*, Project Talent, University of Pittsburgh, 1966.

over which anyone has much control, with the possible exception of entrance requirements in schools of education. The average I.Q. scores for students who matriculate in schools of education typically are lower than those of students entering other departments of universities.[4] Since education schools generally accept far more students than there are jobs, this would suggest that schools of education should greatly restrict their entrance quotas.[5]

It might be possible to interpret the verbal aptitude measure as representing a teacher's ability to communicate which is, however, a skill that may be taught. This would suggest that schools of education should stress the training of this skill in their curricula.[6]

Service Delivery Procedures

Significantly, a number of research studies suggest that the relationship between teacher characteristics and educational outcomes may be conditioned to a substantial degree by the way in which school services are delivered. Factors often examined include: (1) teaching methods; (2) patterns of pupil-teacher interaction; (3) pupil grouping; (4) the use of television and other electronic teaching aids; (5) team teaching, and (6) stability of teacher performance.

1. Teaching Methods

Finding. Researchers have made few studies relating teacher classroom performance to objective tests of pupil achievement.[7] One survey found five characteristics related consistently to the literature: clarity of teacher presentation, variability of teachers' classroom activities, teacher enthusiasm, the degree to which the teacher was task or achievement-oriented and student opportunity to learn criterion material. One study (not a survey) which related teacher characteristics to pupil creativity found that teachers who were warm, spontaneous and child-centered were most effective.[8]

Interpretation. Few of the traits mentioned above are effected by formal training; indeed persons easily could possess all of these characteristics with little or no formal training. This finding, together with those mentioned above concerning the absence of demonstrated relationships between student performance and teacher degree and certification level, strongly suggest that the

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[4]See Folger, John V., *et al.*, *Human Resources and Higher Education*, Russell Sage Foundation, Commission on Human Resources and Advanced Education, New York, 1969.

[5]However, this would run afoul of a powerful interest group in American education, professors in schools of education, whose resources depend largely upon the number of students they attract. This is an area where state legislatures have direct power to institute policy changes.

[6]Dr. Nancy Bruno pointed out this possibility to the author.

[7]Relatively more studies relate teacher classroom techniques to such things as supervisor rating; but research has not shown that such ratings are systematically related to student performance and so such studies are irrelevant for our purpose.

[8]Averch, *et al.*, pp. 55-57.

training methods used in American education—which are those associated with the independent professionals delivery model[9]—are not working properly.

2. Student-Teacher Interaction

Finding. There is evidence that teachers are more effective with some types of students than with others.

Interpretation. This finding strongly suggests the need for a service delivery method which encourages specialization. It also suggests that the considerable body of past research trying to find the best teaching method has been a quest for a nonexistent Holy Grail.

3. Grouping

Finding. There is considerable evidence that classroom grouping, or tracking, on the basis of ability, does not promote any difference in achievement. However, researchers summarizing the literature concerning grouping point out that teachers seldom give differential instructional treatment to different groups.

Interpretation. The first part of this finding seems to contradict the idea that significant positive gains in efficiency might result from specialization, but when the second part of the finding is added such a conclusion could still be valid.

The grouping results also relate to the class size question. Thus there are a number of possible reasons why smaller class size might be better. One is that the teacher can individualize instruction more, although the effects of change from 32 to 28 children in the class, for example, may be minute. Another possibility is that in smaller classes, the teacher can deal more effectively with atypical pupils and "trouble-makers." But a little thought shows that this may be a clumsy and expensive method of dealing with such a problem; another, possibly a better approach, would be to separate the trouble-makers into individual sections.

4. Electronic Teaching Aids

Finding. Researchers have made a large number of studies comparing the use of instructional television and programmed instruction for conventional instruction. This research seems to show conclusively that, for the instructional tasks for which these two media are suited, there is no difference, on balance, whether instruction is conventional or unconventional.

Interpretation. The resource implications of these findings are highly significant. They mean that educators should use whichever technique costs the least.

However, the limitations of educational technology modes are important.

[9]By "independent professionals delivery model" is meant the mode of service delivery such as used in law or medicine where the professional is given thorough training and then performs service throughout his or her career in relatively unsupervised manner, except for the guidance of professional associations and codes of ethics.

Television is useful for lectures but is less useful for instruction which requires interaction with the teacher.[10] Programmed instruction works for drill-skill practice, problem solving and for subject matter such as math and logic which has a highly structured logical sequence. Obviously, if there were specialization of instructional tasks, teachers could spend more time on small group discussion and individual tutoring, leaving lectures and drill-skill to these other methods or to paraprofessionals according to cost considerations.

a. Commercial Quality National Television Instruction for Preschoolers.

The most widely known use of the electronic media for education is national television instruction for preschool children in such programs as Sesame Street and the Electric Company. These programs have succeeded in raising the language ability of entering kindergarten pupils and first graders throughout the nation, even in ghetto areas, where research shows regular viewing rates top 90 percent. The cost per pupil viewing hour is only a few cents.

Interpretation. Sesame Street, more than anything else, has demonstrated the potential of television when widespread use justified the production of professional high quality software. Similar quality software probably could raise the level of instruction in numerous other subject areas in elementary and secondary schools at much lower costs than at present if only school organizations would encourage wider use.

b. Television Instruction Inside the School District.

In some cases, medium and large-sized school districts have been able to use television for some instruction on a continuing basis. This is especially true when the district is spread out geographically. Perhaps the best example is in Washington County, Maryland, which has been using television instruction on a regular basis for a number of years. Television has enabled Washington County to present courses in all of its schools which otherwise would have been possible in only a few schools. After the introduction of television there was a noticeable gain in achievement performance in most subjects taught.[11]

In Washington County large groups of students viewed the television and then participated in classes in the same large group without problems. In one case: "...a junior high school teacher formerly taught five sections of thirty pupils–150 pupils–every school day. This same teacher might now have during the first period of each school day, 120 pupils (or four sections of thirty) in an auditorium for a large-group television lesson. During the remainder of the day, he might meet each of these four sections, one-by-one, for classroom work. Thus, at the end of the school day, the teacher has, in effect, taught eight

[10] However, television instruction can be designed with an interaction capability.

[11] Washington County, Closed Circuit Television Report, Hagerstown, Maryland, 1963. Television use for required and optional courses by percent of weekly class time by grade is as follows:

PERCENTAGE OF CLASS TIME

Grade	Required Courses	Optional Courses
1 through 6	10.2%	14.5%
7 and 8	33.3	33.3
9 through 12	10.0	15.0

sections, whereas before he taught five; yet his workload is lighter, because he grades and keeps records on only 120 pupils instead of 150. Television thus makes this teacher the equivalent of one and three-fifth's pretelevision's teachers.[12]

Teachers themselves do most of the televised instruction. There is not enough information to indicate accurately the costs, although it appears that the additional cost per pupil is positive, but not large.

Interpretation. The Washington County experience demonstrates that it is feasible for even a single relatively large school district to use television instruction routinely. If groups of districts could cooperate easily in television instruction, this undoubtedly would cut the costs and improve the quality of some teaching. One possibility for an organizational mechanism to achieve such cooperation is the intermediate district discussed below.

In the past ten years, computer-assisted instruction has developed to a point where it now seems workable in many circumstances. Computers can be useful in assisting instruction in problem solving or in subjects in which students must learn a highly organized and sequential set of concepts, such as in logic, grammar, mathematics and reading vocabulary. The method usually involves messages and questions which establish whether the student understands the material just presented. If the student makes a correct answer through a fortunate guess, most programs are written in a way that the student then will make mistakes further along in the sequence of instruction, at which time the computer will return the student to the proper point earlier in the presentation to try again.

Most computer-assisted instruction has taken place in colleges or elementary schools. In elementary schools, Suppes and his associates at Stanford University have demonstrated that young children, disadvantaged or not, after using computer-assisted instruction, show gains in reading and arithmetic that are, on the average, at least as great as those obtained through traditional instruction.[13]

Colleges have used some of the most interesting forms of computer-assisted instruction. Designers of the systems easily could adapt them for use in elementary and secondary schools. One example is Project PLATO, at the University of Illinois. In this highly sophisticated program a display screen will show pictures and tables to the student. The student can draw figures on the screen for such exercises as geometry lessons and other written work. PLATO can provide a wide variety of instruction in language, mathematics, the sciences and many other subjects. An example of dialogue between the "computer" and a student will show the flavor of what can be done. The following example is from a chemistry laboratory exercise. It is noteworthy that the dialogue appears on the display screen, as do such things as tables of weights and the spectra which is displayed in color. It should be noted that the program is sophisticated enough to recognize spelling errors.

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[12]Washington County, Closed Circuit Television Report, *op. cit.*, p. 6.

[13]Jamison, Smith, Suppes, Wells, *op. cit.*, p. 65 ff.

Student: *What color is it?*

PLATO: The solid is white and the liquid is colorless.

Student: *What is its melting point?*

PLATO: The melting point is 19-20°.

Student: *What does the nmr look like?*

PLATO: This is the 60 MH_z proton nmr spectrum. For a table of chemical shifts, press DATA. (The spectrum is shown on the screen.)

Student: *What is the unknown soluble in?*

PLATO: Please provide more information.

Student: *Is it soluble in H_2SO_4?*

PLATO: The unknown is soluble in cold conc. H_2SO_4.

• • •

Student: *Where does it boil?*

PLATO: The boiling point is 195-200° at 760.

Student: *Permanganate test.*

PLATO: The unknown reacts slowly with $KMnO_4$.

Student: *Tin and HCl*

PLATO: Please forgive. . .The following words are NOT in my vocabulary. . .Tin.

Student: *Tollens.*

PLATO: There is no reaction with Tollen's reagent.

Student: *The unknown is Acetphenone.*

PLATO: SP.

Student: *Acetophenone.*

PLATO: OK

For a new unknown press NEXT.[14]

Mitre Corporation now is concentrating on developing courses for the junior college level. Each course costs approximately $1.5 million to develop. For a reasonably large junior college, the cost would appear to be about the same as for PLATO, about $.50 per student contact hour.

Importantly, the feasibility of using computer-assisted instruction has been demonstrated for a variety of educational tasks. Two things are necessary to make it feasible for elementary and secondary schools. First, a number of school districts must cooperate to share the cost of central computer facilities. This should not be difficult. Second, schools must have enough flexibility so that they can use computer-assisted instruction as a *substitute* for some of the

[14] D. Bitzer, B. Sherwood, P. Tenczar, "Plato: Everyone's Answer," in *PROCEEDINGS*, Third Annual Frontiers in Educational Conference, Institute of Electrical and Electronic Engineers, New York, 1973, p. 361.

classroom time of the accredited teacher. This means that while students are learning at computer terminals, the teachers are employed profitably elsewhere.

c. Computer-Managed Instruction.

Diagnostic-prescriptive techniques seem to succeed in teaching children with learning difficulties. Indeed, one serious criticism of traditional methodology is that teachers cannot fulfill the needs of specific children, especially atypical youngsters. The originators of computer-managed instruction, such as Westinghouse Learning Corporation's Project Plan, hope to increase classroom teachers' diagnostic-prescriptive capability by periodically giving students tests on the subject matter and checking with the computer's memory to see which skills seem lacking. The computer is also programmed to indicate which exercises teachers could assign in widely used texts and what supplementary material they could use in order to deal with the problems discovered.

Educators now are using similar techniques in teaching more than 30,000 pupils nationwide with reasonable success. Cost per pupil is about $60 a year.

Interpretation. The potential impact of computer-managed instruction is highly significant because it includes middle management expertise. This should make it possible to individualize instruction in ways that many critics of present curriculum methods feel are highly desirable and, at the same time, preserve the present organization of delivery by the independent professionals. Thus, there could be a significant improvement in instructional quality at reasonable cost.

5. Team Teaching

Team teaching resembles differentiated staffing in that it usually employs teacher specialization. However, organizational requirements for team teaching are closer to present patterns than differentiated staffing. Therefore, team teaching requires a separate discussion.

The concept is simple: two or more teachers, usually with teaching certificates, receive responsibility to instruct the same group of pupils. This usually means that at least part of the time, the teacher team is interacting in the same classroom. (Otherwise, traditional high school instruction could be called team teaching.)[15]

Interpretation. Team teaching is of interest here because it uses specialized techniques but does not necessarily require the more complex management structure of differentiated staffing. Since it requires additional staff, it could be fairly expensive, however.

6. Stability of Teacher Performance

Finding. The Averch *et al.* survey of the consistency of teacher effectiveness concludes that, "although teachers may vary in skill, their effectiveness does not appear to be generalized over time or topics."[16] Teacher performance seems

[15]For a discussion of team teaching, see Educational Inquiry, Inc., *Schooling for the Future*, Los Angeles, California, 1971, pp. 94-96.

[16]Averch, *et al.*, (1972), p. 58.

to be inconsistent in presenting the same material over time, in teaching different topics, and in teaching different types of students.

Interpretation. This finding, which is, however, not based upon a large number of studies, is helpful from the standpoint of resource use. If teachers vary widely in instructional effectiveness according to the topic and type of student, this implies that gains could result from specialization of teaching tasks. This, in turn, suggests the possibility of gains from differentiated staffing organizations which can exploit specialization possibilities.

Service Organization

In addition to examing the effects of the way educational services are delivered, a great deal of school productivity research inspects the consequences of a closely related factor, the way in which second services are organized or structured. Aspects of this factor which have been examined include: (1) the pupil-teacher ratio and class size; (2) supervisory structure; (3) staffing innovation; (4) "alternative schools"; (5) intermediate districts; (6) performance contracting; (7) year-round schools; and (8) physical facilities.

1. Average Class Size and Pupil-Teacher Ratio

Finding. Average class size and pupil-teacher ratios are closely related. However, the findings for the two factors differ somewhat. In five studies, about half of the possible relationships for average class size had the expected relationship. On the other hand, at least seven studies considered pupil-teacher ratio and none of these found the variable to be significant.

Jamison, Smith, Suppes and Wells have made what is perhaps the most complete and objective survey of experimental class-size studies. They conclude that although many studies have favored both larger and smaller classes, on balance and with one exception, the evidence suggests no difference. The exception is that a small class seems to improve the performance of very young children.[17]

Interpretation. The difference between average class size and pupil-teacher ratio sometimes results from the practice of using teachers for non-classroom duties, such as counseling. However, as most school districts collect statistics concerning these variables, the difference should be minor.

The findings tend to show that there may be some evidence that smaller class size matters for small children but little evidence indicates that it matters at other levels. Since class size is the single largest determinant of expenditure, the implications are obvious. These findings suggest that educational policy makers would do well to pursue such money-saving devices as large lectures and televised instruction, at least above the lowest elementary school grade level. They could achieve this within the present system of high school instruction although it may be more effective to establish some form of differentiated staffing.

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[17] D. Jamison, *et al., op., cit.*, p. 30 ff. Meant by "very young" are pre-schoolers and children in the lower elementary grades.

2. Amount of Supervisory Staff

Finding. Only three studies looked at the relationship between the number of supervisory personnel (of the amount of money spent on them) and student performance. In two of the studies the ratio of principals and supervisors to students was related consistently to student performance. In the third study, there was no positive relationship between student performance and expenditures on administrators.

Interpretation. Management resources seldom are studied in this literature; obviously researchers consider teacher characteristics to be the only important factor in the delivery of American education. There may be some possibility of increasing educational returns by increasing management resources, even in the present delivery system, but the evidence is too meager to conclude with much certainty. Both this finding and that for the physical facilities tend to support the idea that the classroom teacher is an independent professional as opposed to a supervised worker.

3. Staffing

As indicated above, the fact that both learning experiences and pupil types are diverse suggests that specialization and division of labor might be applicable to education. The organizational plan designed to specialize instructional tasks would be some form of differentiated staffing.

The chief management of day-to-day instruction in differentiated staffing plans comes from a master-teacher/team-leader who may direct a team of senior teachers, junior teachers and paraprofessionals. Using guidelines set by the school principal, the master-teacher decides upon the schedule for the perhaps 150 students for whom he or she is responsible. Grouping of children for the responsibility of each team can be based on either the children's age or along subject lines. Skillful use of paraprofessional aides, who typically cost only about one-fourth as much as credentialed teachers, can lower costs considerably.

The master-teacher and principal assign some teachers to lecture, some to lead discussion sessions, and others (perhaps beginners or paraprofessionals) to help students with drill-skill practice sessions. They also may assign teachers and aides with specialized abilities to deal with individual student needs. Different members of the staff also can perform such functions as counseling and evaluation.

Interpretation. One of the most outstanding features of differentiated staffing is its flexibility. The capacity of such strategies to use potential variations in program and curriculum is almost endless. This method can use educational technology and can adapt organizational features to shape programs consistent with available budgets. There is much more middle-level management than under the present system. Because of the great flexibility of this method it is possible that educators could design plans that would be either more or less costly than present methods.

4. Alternative Schools

A growing number of school districts are beginning programs in which some

children can choose to attend schools in which teaching methods differ considerably from traditional American instruction.

These schools often use variations of "open education" in which instruction usually is informal and based mainly upon the interests and abilities of the students rather than upon the traditional formal curriculum. Such schools have proven popular with many students who dislike the more traditional classroom. Many secondary alternative school programs of this kind have succeeded in reducing dropout rates. However, there is little evidence that this approach increases or decreases student achievement in basic subjects although it probably declines somewhat in the most permissive programs.[18] (Most public school alternatives are not highly permissive, although they are considerably more permissive than the regular classroom.)

There is usually some possibility of choice on the part of the student and many alternative schools have sizable waiting lists. However, it is not uncommon for students living in an alternative school attendance area to choose a traditional school farther from home. One of the more interesting sets of alternative schools is the Southeast Alternative Program in Minneapolis. In the southeast district there are three alternatives available, plus the possibility that students can attend schools outside the southeast district if they wish. One school has a vocational orientation, the second is fairly similar to a traditional school with some open classroom features, and the third is a more complete open school with informal instruction and individualized programs. It is noteworthy that the formal open classroom has gained enrollment at the expense of the more traditional school, while the enrollment of the vocationally oriented school has remained about constant.

Interpretation. The alternative school idea represents an innovation whose implications are not well understood either for education or for other local government sectors. For one thing, alternative schools introduce the idea of client *choice* in the consumption of local public services, and this, in itself, is most novel. Even more significant, in some places these schools are very close to presenting a system of competition within the public sector. If these systems took one further step—directly or indirectly rewarding school personnel on the basis of how many students choose their schools—this would introduce into education the operation of a market mechanism similar to the competition for buyers in the private sector of the economy.[19] One result might be organization

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[18] See L. Sussmann, "The Role of the Teacher in Selected Innovative Schools in the United States," DAS/EID/71.46, Organization for Economic Cooperation and Development, Paris, 1971, Mimeo, p. 40 ff.

[19] Some of this type of competition probably exists already in several places. Schools of course get money allocated on the basis of attendance. Undoubtedly, school personnel lose prestige when their schools lose attendance. The limitation is the fixed size of schools to which students are transferring. To some extent, a waiting list probably imparts the same set of signals as actual attendance gains.

The purest example of a market innovation is the voucher idea. This concept, actively discussed as long as 200 years ago, was reviewed in popular discussion in a book by Milton Friedman, *Capitalism and Freedom*, in 1962. NCSL's study has not discussed vouchers at length because no system so far has used them in anything like pure form.

of service delivery which is both efficient and popular with students and parents, although not necessarily with the professionals themselves.

5. Intermediate District Arrangements

Organizations have formed in several states to provide special services to a number of school districts (especially small ones) which the school districts themselves cannot provide well. Some examples include management information systems, management consultation and help with program evaluation. In some states, these services are free; in others, the school districts must purchase them, although, with state subsidies, the price typically is below cost.

One of the most interesting arrangements are the Boards of Cooperative Educational Services, or BOCES, in New York State. Each BOCES maintains a staff of specialists in management, testing, evaluation and other support services which school districts are likely to require. School districts must purchase services, but with dollars matched one-to-one by the state government. There are 46 individual BOCES in the state. They vary in depth, quality and type of expertise according to patterns of district demand and the entrepreneurial ability found in each.

Interpretation. This innovation has far-reaching implications for the delivery of education. The arrangement eliminates the most important argument for the benefits of large school districts—the economies of scale in many managerial and staff functions. Many observers of large school districts have noted that they often tend to maintain large, cumbersome and unresponsive staffs.[20] The intermediate district arrangement could provide such services in a much more responsive fashion. Because the success of the supplying agency would depend upon the amount of services purchased by clients, it is likely that they would be more innovative, more responsive and more efficient than present school bureaucracies.

6. Performance Contracting

In the past few years, private firms have undertaken several dozen projects to educate pupils with remuneration based upon gains in standardized reading tests and other measures. The Office of Economic Opportunity financed many of the projects through the 1971 school year and reached pessimistic conclusions about the value of the approach.[21] Despite this experience, a number of successful projects currently are under way and the idea is not dead.

Payment schedules usually provide a maximum of $100 per child for success

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[20] See, e.g., M. Gittell and T.E. Hollander, *Six Urban School Districts*, Praeger, New York, 1967. This literature is discussed in Averch, *et al.*, *op. cit.*, pp. 93-100.

[21] The OEO conclusion probably was premature, especially since OEO experiments were given only a year to succeed, and performance contracting is a market device which would require more time than that to work properly. Firms doing poorly must have time to go out of business and be replaced by more successful firms (of which there were some in the OEO experiments). A good discussion of the performance contracting experience thus far is to be found in H. Mecklenberger, "Performance Contracting in Schools," National School Public Relations Association, Washington, D.C. 1972.

in a single subject, usually reading, and the final payment usually amounts to one-half to three-fourths of that amount. There are instances both in Michigan and Florida where school districts have contracted with groups of their own teachers. This variation usually seems to work well. In Dade County, Florida, one group of teachers achieved much higher pupil gains than in prior years and, at the same time, raised the established teacher-to-pupil ratio to more than 40-1.

The primary problem in performance contracting is that educational measures are far from foolproof. Nevertheless, a fair number of projects seem to be working by standards most reasonable people would accept as legitimate.

Interpretation. Extensive use of the performance contracting idea would change substantially the delivery of American education from a system that is controlled and staffed by professional educators with special credentials to one in which the private sector would provide part of the staffing. This innovation moves a service traditionally provided by a public bureaucracy much closer to the organization of the private marketplace, with all the implications that market mechanisms entail. Suppliers in these arrangements have shown a marked propensity to use new and novel methods of delivering instruction. This has happened even when suppliers were classroom teachers trained in traditional methods. The method also tends to lower costs. What is not known is how far educators can carry the concept in the light of testing limitations.

7. Year Round Instruction

One of the more obvious ways of lowering educational costs would be to change the inefficient use of buildings and time which now exists. Students attend school six hours a day (one-half of what could be achieved easily) for one-half of the year (180 days). Thus, school facilities generally are used only 25 percent of the time.

A number of school districts have shifted to year-round schedules with apparent success. Discussions of the idea frequently focus on the 45-15 plan, originally developed in Lockport, Illinois. Under this plan, each of four student groups spends nine weeks (45 days) in school four times a year with three week (15 days) vacations between school sessions. Thus, at any one time, only three of the four student groups are in school and they require only three-fourths of the building space that the total student body would need under the conventional system.

Interpretation. The Lockport experience is now about four years old and little opposition to the project has emerged in the community. Cost savings have been estimated to be three to five percent of total operating costs. Some additional savings also result from increased use of such supplies as encyclopedias and atlases.

Educational Turnkey Systems, Inc. estimated that for a middle school in Prince William County, Virginia, the 45-15 plan would reduce yearly costs from $1,134 per pupil to $1,033 per pupil, or 9.6 percent.[22]

Year-round plans would increase the flexibility of educational delivery

[22]Educational Turnkey Systems, Inc., "45-15 and the Cost of Education," Washington, D.C., 1972.

because they make it possible to specialize tasks over time and to make adjustments in the progress of students which are much more difficult to make now.

8. Amount of Physical Facilities

Finding. Four studies included variables relating to the amount of physical facilities used. Two studies found positive relationships, including one that found the amount of science laboratory facilities related to science achievement in a large sample of high schools.

Interpretation. The scarcity of studies which consider physical facilities is a clue to the unimportance researchers attach to this factor. Even in the two studies that found positive relationships, the relationships are not consistent enough to conclude that there is much demonstrated connection between physical facilities and student performance.

Outcomes Relating to Pupil Characteristics

Some of the most important data sets gathered for multivariate studies were intended to investigate the status of socially disadvantaged children. The problems of such children with American educational practices are important enough to merit a separate discussion.

Finding. The most important set of findings for disadvantaged children are those found in the Coleman Report, which concluded that a complex of the most important school characteristics was almost completely unrelated to pupil performance, explaining two percent or less of the variation in test scores. However, the Coleman Report methodology was faulty, and this accounts for some of the negative results in the findings. Using the same data, Hanushek showed that both teacher experience and teacher verbal scores related significantly to the test scores of the black children, a majority of whom were disadvantaged.[23] The general thrust of findings from relevant studies, whether they are based on the Coleman data or on other sources, indicate that school and teacher characteristics generally relate much less to the progress of children from disadvantaged backgrounds than they do to the achievement levels of more highly motivated children from middle class backgrounds. One partial exception is the finding from a study of Title I projects in California which indicated that individualized instruction by trained reading specialists consistently was related to the reading gains of children from disadvantaged homes.[24]

Interpretation. It appears that the traditional delivery method used in American education is not highly successful with children from disadvantaged

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[23]Eric Hanushek, "The Education of Negroes and Whites," Ph.D. dissertation, Massachusetts Institute of Technology, 1968.

[24]H.J. Kiesling, "Input and Output in California Compensatory Education Project," R-781-CC/RC, The Rand Corporation, Santa Monica, California, 1971. This study showed an average gain for pupils in a ten percent sample of California pupils to be .87 months gain per month of instruction. This is .13 months less gain than the "national average" of pupils for which the test was normed but considerably more than the .65 or .70 figure that often obtains for such children.

homes. Two main reasons probably account for this lack of success. First, teacher training institutions prepare teachers to educate "normal" children, motivated according to middle-class values. Second, instructional pacing is almost always of the "group" type, in which all children receive the same classroom experiences and all children are expected to achieve the same progress. Once students begin to fall behind this minimum acceptable pace, schools often do not have resources available to correct the situation, and the students fall further and further behind until they get lost.

Only the organization of instructional delivery can be blamed for this. Teacher loads in American education are designed to deal with students who are both motivated and prepared. Where these factors are missing, teacher loads are much too heavy to permit much instruction and learning. In general, the fact that different groups of children in the same classroom have demands that schools usually cannot meet at the same time suggests the need for a delivery system that can provide specialized services for different types of students.

PART III

Conclusions From the Examination of Research Findings

Although sometimes contradictory, existing research on public school productivity offers many suggestions for alternative methods for delivering instruction in the nation's schools. In this concluding section we discuss ways of implementing these suggestions.[1] To set the stage for this discussion we begin by briefly discussing some factors which seem to impede educational change.

Resistance of Educational Institutions to Change

It would be wrong to suggest that all resistance to change on the part of institutions, educational or otherwise, is pathological, since a degree of stability is healthy for all institutions. Still, many agree that American elementary and secondary education has been somewhat resistant to major changes and it is instructive to briefly consider why.[2]

There seem to be a number of reasons. Perhaps most important is the fact that there seems to be no good place to introduce change. Decision-making power is widely diffused: the teacher is quasi-independent in the classroom, curriculum is set in a number of places, professors at state universities dominate the teacher training process, and colleges demand good scores on standard entrance examinations for admission. Finally, innovators in education often have little to gain in terms of personal rewards, except perhaps the hostility of many of their peers.

Another difficulty which impedes changes is a notable absence of stated operational goals in American public schools. This causes two problems. First, it is difficult to plan change if the object of the planning isn't known. Second,

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[1]It should be noted that no position is being taken here about the desirability of *specific* changes. Rather, the thrust of this section is that key educational policy-makers should develop the knowledge needed to *consider* change, and that, if changes are deemed desirable, it ought to be made possible to implement them.

[2]This is not the place for a detailed discussion of factors inhibiting educational change. For good discussions which are more detailed, see John Fincus, "Incentives for Innovation in the Public Schools," Mimeo., The Rand Corporation, Santa Monica, California, 1972, and M. Bentzen and K. Tye, "Effecting Change in Elementary Schools" in J. Goodlad and H. Shane, editors, *The Elementary School in the United States*, University of Chicago Press, 1973, pp. 350-379.

without a clear set of goals carefully explained to the community, the professional education community tends to be most hesitant to engage in any practice that seriously offends any significant group of the population. This means that schools sometimes are locked into the practice of doing only safe and "non-controversial" things, a situation which almost always excludes innovations which would require substantial change.

Finally, there are forces which make it difficult for legislators to obtain information on available options—the issue that has been discussed in this monograph. The most important of these is simple and yet extremely powerful; the only persons with *both* the expertise and the organizational clout to effect change are those who often have a personal stake in leaving the system as it is. In general it is true that those with expertise lack power and those with power lack expertise. This may seem simple in theory, but it is extremely important in practice, and it is necessary to understand the situation thoroughly in order to encourage a desirable marriage of power with expertise.

Implementing the Consideration of Educational Options

Bearing in mind the institutional framework within which decision-makers must operate, how might they obtain information concerning available educational options? There must be numerous possibilities in this regard, and these, together with a discussion of implementation strategies, could easily be the subject of a fair-sized book. There are three methods which would seem to show the most immediate potential, however: mandating the definition and measurement of educational goals, providing better staff capability and encouraging the construction of demonstration projects.

Defining Goals

State legislatures could take an important first step toward improving the methods of evaluating educational options if the lawmakers would mandate further work on the definition and measurement of the educational product. The experience in Pennsylvania (after the passage of such legislation in 1963) is evidence that this direct strategy can be fruitful. The definition of goals and the construction of related measures is crucial for the development of more analytical methods for studying either productivity or effectiveness. Since the process of developing educational goals and constructing related educational measures is an iterative one, the point at which work in this field begins is less important than the beginnings themselves and persistent follow-up. Thus, in passing such laws, State legislatures should require not only that the process be started, but that it be constantly reviewed and evaluated. If the States do this, time and patience should lead to the discovery of much more useful ways to define and measure the educational product, subject, of course, to the limitations discussed earlier.

Improving Staff

While defining goals and constructing measures are necessary for future progress, more immediate help would be forthcoming to decision-makers through the simple strategy of strengthening their staff capabilities. For the type of inquiry discussed above in which observers could make comparisons of educational quality based upon informed judgments instead of explicit measurement, the increase in staff required should be relatively modest. Indeed, it would not be necessary for the individual States to do the more general aspects of this work such as describing the general options available. The National Institute of Education, other Federal agencies, groups such as the Education Commission of the States, the National Conference of State Legislatures, and even private foundations, could sponsor such research. It would be important that these organizations tailor this work to the decision-makers in legislatures and on school boards. Researchers gathering information for the use of members of education committees of State legislatures should bear in mind the specific needs of the lawmakers, including any constraints that might be relevant. Staff support agencies working on this kind of research also should be able to provide a well-developed question answering capability.

For example, if it were evident that members of State Legislative committees on education in several States were asked similar questions about the value of using educational television to carry out State-wide, or regional, instruction in vocational education, a good staff support agency could provide State legislators considerable useful information. This could include what is known about software availability, what actions are necessary to develop high quality software, the costs for the two or three main delivery methods, how to find out where usable cable facilities exist, what is known about the strengths and weaknesses of televised instruction in general and televised vocational education instruction in particular. Of course, it would be useful if State legislatures and other important decision-making bodies would spend the relatively small amounts of money needed to build up their own staff capacities. Because professional educators tend to have a stake in the *status quo*, it is necessary, for the sake of objectivity, that these staff members should be under the control of the decision-makers themselves and not borrowed from some agency inside the professional education establishment.

Constructing Demonstrations

The third suggestion is important to decision-makers at all levels, but particularly to Congress, State legislatures, agencies such as the National Institute of Education, and private foundations. This strategy involves encouraging the construction of useful demonstrations of various options for education. Demonstrations, if done well, can provide information which is extremely helpful: the key difficulty, of course, is making sure that they are done well. Those who wish to design effective demonstrations should make them resemble, as closely as possible, actual school situations. Personnel should not be

more highly skillful or more motivated than those in the day-to-day operations of the school which eventually might adopt the demonstration program. Observers also should monitor the demonstrations long enough to let the novelty wear off and to permit the teachers to settle into a routine.[3] Some experiments may require a time period of one or two years merely to overcome the initial inertia and hostility to the new idea.

Demonstration projects frequently illustrate the entrenched opposition of experts on education to change when they have a stake in the existing system. The story is, by now, familiar. Decision-makers must go to professional educators to get qualified staff for demonstration projects and the staff promptly sabotages the demonstration itself through a variety of subtle and not so subtle methods. (It is usually possible to get project *leaders* who are sympathetic to the project, because many professional educators are highly critical of many educational practices; the real problem is to find a staff which is neutral.)

Unfortunately, no easy solutions exist for the problems of improving educational productivity. However, with careful thinking, decision-makers can do much to improve the situation. Choosing staff from outside the ranks of professional educators is one possible approach. Another would be to construct projects that would not be threatening to the staffs of the existing schools. Heavy involvement in staffing and staff training by relatively impartial research organizations, such as the National Institute of Education or the Rand Corporation, would be useful.

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[3]Some types of experiments, for example those which introduce the working of markets, require time as a necessary *ingredient* to the demonstration itself. This point was forgotten in the performance contracting experiments conducted by the Office of Economic Opportunity, which were allowed a period of only one academic year when the essential market mechanism of performance contracting (allowing successful firms to prosper and spread and unsuccessful firms to drop out) would require at least two or three years to begin to operate correctly.

Summary Conclusions

Rising concern over the productivity of public schools has evoked increasing research directed toward discovering ways to improve the effectiveness of elementary and secondary education. Most of this research has focused on the relationship between productivity and four groups of variables (1) teacher characteristics; (2) the organization of local school services; (3) the procedures used to deliver local school services; and (4) pupil characteristics. The principal findings which emerge from this research are as follows:

- School productivity is dependent on a complex set of factors which often do not lend themselves to short-run control by State and local school administrators. These include such important variables as teacher personality characteristics, the composition of professional staff skills, school district boundaries and the socio-economic background of pupils.
- School productivity can be improved substantially over the long run, but to do so may require overcoming several deep-set and incorrect notions about productivity. These include, most importantly, the idea that productivity is strongly related to staff credentials and degree status, and the idea that parents and children should have little control over the supply of educational alternatives—that educational alternatives should be controlled overwhelmingly by professionals.
- School productivity research indicates that capital-intensive instructional media, such as "teaching machines" or television, perform as well, on balance, for the tasks for which they are applicable as does face-to-face instruction. This suggests that greater productivity could be achieved by using advanced instructional devices wherever they cost less than traditional methods.
- School productivity can be improved significantly by more fully implementing several time-tested principles of management and organization. These include sometimes conflicting principles of staff specialization; maximizing the upward flow of information within management; specifying organizational goals that are clear-cut and to which schools can be held accountable; and insuring a close match between professional authority and competence.

- School productivity will be difficult to improve without adopting changes in educational governance that increase the capacity of local school districts not only to evaluate their performance, but also to act in response to their findings.
- School productivity issues are sufficiently complex that State Legislatures cannot expect to deal with them fairly and effectively unless they equip themselves with the capacity to oversee school operations on an ongoing and professional basis.

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